

NRC Medium Voltage Circuit Breaker Training



CHAPTER 5

CIRCUIT BREAKER MAINTENANCE

Learning Objectives



- Understand the difference between preventive maintenance (PM) and overhauls.
- Understand the elements of a good preventive maintenance process.
- Explain the three elements of a preventive maintenance inspection.
- Understand differences in overhaul levels.
- Have a general understanding of the lubrications used by breaker manufacturers.
- Understand the uses for penetrating oils in the preventive maintenance process.
- State the three common potential breaker failure causes.
- Understand the use of breaker timing analysis and the potential failures it can uncover.
- Understand the benefits and potential misinterpretation of contact resistance testing

MAINTENANCE RULE



- Medium voltage circuit breakers meet the maintenance rule criteria and qualify for monitoring under the Maintenance Rule program.

WHY BREAKERS FAIL



- The cause of most breaker failures can be attributed to one or more of the following areas:
 - lubrication failure
 - improper maintenance process not
 - not performing maintenance
 - Improper maintenance
 - component failure

Medium Voltage Circuit Breaker Maintenance



- Routine inspection, testing, and maintenance ensures that:
 - a circuit breaker is operating properly
 - the breaker adjustments are within specification
 - potential component failure can be detected
 - data is available to better evaluate the condition of the breaker

PM vs. Overhaul



- PM's are basic short term maintenance to make sure a breaker is working properly
- Overhaul is a major service to renew lubrication and will require a greater degree of disassembly and inspection to perform an evaluation of breaker components

Preventive Maintenance (PM)



- Plant personnel normally perform
 - On set schedule
 - Other considerations - operations and environment conditions

PM Inspection



- A good preventive maintenance inspection should consist of:
 - Good visual inspection
 - Adjustment verification
 - Electrical and mechanical testing

Who is performing plant overhauls



- Plant personnel
- Original breaker manufacturers (OEM's)
- Other service shops

Overhaul Process



- All overhaul processes to be effective at a minimum should address:
 - lubrication
 - component evaluation
 - and industry recommended replacement parts
- All of the following overhaul levels will.

Three overhaul levels



- Level 1 - Minimum
 - Disassembly of operating mechanism, and contact pivots
 - Cleaning, and lubrication
 - Replace industry recommended components
 - Evaluate breaker components for wear and damage
 - Replace as required.

Three overhaul levels



- Level 2
 - Complete disassembly of the breaker
 - Replate mechanism metal components
 - Evaluate silver plating and replate as required
 - Clean and lubricate
 - Replace industry recommended components
 - Evaluate breaker other components for wear and damage and replace as required.

Three overhaul levels



- Level 3
 - Complete disassembly of the breaker
 - Replate mechanism metal components
 - Silver plate all copper bus and contacts
 - Clean and lubricate
 - Replace industry recommended components
 - Replace all potential high wear items
 - Evaluate breaker other components for wear and damage and replace as required

How frequently should overhauls be performed?



- OEM standard
- EPRI - User group recommendations
- Individual plants

BREAKER INSPECTION PROCESS



- Visual inspection
- Exterior and interior appearance
- Racking mechanism if applicable
- Ground stab, and interlock
- Arc chutes and insulation barriers (After removal)
- Main and arcing contacts and arc puffer
- Primary Bushings
- Primary Contacts (Used to connect to the cubicle)
- Secondary Contacts (Used to connect the control contacts to the cubicle)
- Wiring, relays, coils, switches and charging motor,
- Operating mechanism,

BREAKER INSPECTION PROCESS



Adjustments

- Mechanism adjustments
- Contact adjustments

Breaker electrical and mechanical testing



- Breaker timing
- Time travel analysis
- Contact resistance measurement (micro-ohm)
- Insulation testing (meggering)
- Over potential (hipot) testing
- Vacuum bottle Interrupter integrity test
- Power factor testing (doble)

LUBRICATION



- The 1998 INPO SOER 98-2 on Circuit Breaker Reliability siteded degraded lubrication as the largest single contributor to breaker failures.

Lubrications used on breakers



- General Electric - Mobil 28 - mechanism and contact structure
- ABB - Anderol mechanism NO-OX-ID contact structure. Mobile 28 has recently been approved for operating mechanisms
- Westinghouse/Cutler Hammer use several lubrication
 - BR2 Plus, Graphite/Alcohol mixture , application), Lubriplate 130A, and Poxylube, and special formulation graphite grease.
- Siemens/Allis: uses Beacon P290, 325 or Anderol 732.

Penetrating oils and spray lubrications



- it is not recommended to use penetrating oils and spray penetrating formulas as a lubricant on circuit breakers

Lubrication considerations:



- If it has not been overhauled - should be overhauled immediately.
- If a breaker is in a high cycle function, wear and loss of lubrication become an issue. These breakers need to be constantly evaluated and should be on an aggressive overhaul cycle.
- If a breaker sits in a static position for a long period it should be cycled at least every 18 months.
- Most Synthetic greases have a longer operational life but can still deteriorate over time.